Work / Power

HYDRAULIC HORSEPOWER:

a) $$\mathbf{HP_T} = \frac{\mathbf{GPM \times PSI}}{\mathbf{1714}}$$

HP_T = Theoretical HP

b) Input to pump:

$$\mathbf{HP_{in}} = \frac{\mathbf{GPM \times PSI}}{\mathbf{1714 \times (e_t)}}$$

e_t = overall pump efficiency

c) output of Hydraulic Motor:

$$\mathbf{HP_{out}} = \frac{\mathbf{GPM \times PSI \times (e_t)}}{\mathbf{1714}}$$

e_t = overall motor efficiency

HEAT GENERATION:

BTU/hr = 1.5 x GPM x PSI

PSI=Pressure loss which does not produce work

HEAT RADIATION OF A HYDRAULIC RESERVOIR:

BTU/hr = 2.54 (Av) (∆T)

BTU/hr	=	Heat radiated
Av	=	Vertical tank area in contact with oil
∆T	=	Desired oil temp minus ambient air temperature in degrees Fahrenheit

ESTIMATING IMMERSION HEATERS:

$$\mathbf{KW} = \frac{\mathbf{V \times \Delta T}}{\mathbf{800\ T}}$$

V	=	Tank capacity gallons
∆T	=	(desired - ambient) temperature in degrees Fahrenheit
T	=	Time in hours
KW	=	Input heat required.

POWER:

1 HP = 1.014 metric HP
1 HP = .7457 KW
1 HP =42.4 BTU/min
1 HP = 2545 BTU/Hr.
1 HP = 550 ft - lb/sec

ELECTRICAL FORMULAS

To Find	Alternating Current	
	Single-Phase	Three-Phase
Amperes when horsepower is known	$\frac{HP \times 746}{E \times Eff \times pf}$	$\frac{HP \times 746}{1.73 \times E \times Eff \times pf}$
Amperes when kilowatts are known	$\frac{Kw \times 1000}{E \times pf}$	$\frac{Kw \times 1000}{1.73 \times E \times pf}$
Amperes when kva are known	$\frac{Kva \times 1000}{E}$	$\frac{Kva \times 1000}{1.73 \times E}$
Kilowatts	$\frac{I \times E \times pf}{1000}$	$\frac{1.73 \times I \times E \times pf}{1000}$
Kva	$\frac{I \times E}{1000}$	$\frac{1.73 \times I \times E}{1000}$
Horsepower = (Output)	$\frac{I \times E \times Eff \times pf}{746}$	$\frac{1.73 \times I \times E \times Eff \times pf}{746}$

I = Amperes; E = Volts; Eff = Efficiency;
pf = Power factor; Kva = Kilovolt-amperes;
Kw = Kilowatts.

Power is defined as the rate of doing work. To better describe this term we will use the example we cited earlier. Assuming the book weighs 1 pound and we lift it 3 feet off the table we have done 3 ft.-lbs. of work. It does not matter if we lift it fast (1 second) or slow (1 hour), we always do the same amount of work. It does, however, take more power to lift the book in a lesser amount of time. Consequently, the units of power are defined as the amount of work (ft.-lbs.) per unit time (seconds) or:

$$\mathbf{POWER} = \frac{\mathbf{ft\text{-}lbs.}}{\mathbf{sec.}}$$

The common method of measuring power is known as *horsepower*. Horsepower is defined as the amount of weight (lbs.) a horse could lift one *foot* in one *second*. By experiment it was found that the average horse could lift 550 lbs. one foot in one second, consequently:

$$\mathbf{1\ Horsepower} = \frac{\mathbf{550\ ft.\text{-}lbs.}}{\mathbf{sec.}}$$